R·I·T Title: Tencor P2 Profilometer

Semiconductor & Microsystems

Fabrication Laboratory **Revision: D** **Rev Date: 02/17/2011**

Approved by:

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Process Engineer Equipment Engineer

1 SCOPE

The purpose of this document is to detail the use of the Tencor Profilometer. All users are expected to have read and understood this document. It is not a substitute for in-person training on the system and is not sufficient to qualify a user on the system. Failure to follow guidelines in this document may result in loss of privileges.

2 REFERENCE DOCUMENTS

- Appropriate Tool Manuals

3 DEFINITIONS

n/a

4 TOOLS AND MATERIALS

4.1 General Description

4.1.1 The Tencor Profilometer may be used to measure film thickness and stress on a variety of substrate sizes. The tip shank angle is 45º and the tip radius is 1.5-12.5 microns.

4.2 Stress Fixtures

4.2.1 Stress fixtures for 4-inch and 6-inch wafers may be found near the Tencor.

5 SAFETY PRECAUTIONS

5.1 Personal Safety Hazards

5.1.1 The Tencor has a moving stage which may create a pinch hazard; do not operate with any of the covers removed or any of the interlocks defeated.

5.2 Hazards to the Tool

5.2.1 Be careful not to run the stage into the stylus when using the stress fixture or any tall samples.

5.2.2 Avoid measuring films that will contaminate the stylus.

6 INSTRUCTIONS

6.1 Initial State Check

6.1.1 Turn on the Tencor P2 (Computer and monitor). The system is usually left in a ready state with the computer **ON** and the monitor **OFF**.

6.1.2 Make sure that the stress fixture has been removed if you do not need it.

6.2 Resetting the System

6.2.1 Occasionally the system will lock up. If this happens, reboot the computer.

6.3 Loading a Recipe

6.3.1 Get to the Tencor menu bar by pressing **Esc** until the following menu appears:

RECIPE	SEQUENCE	DATA	ANALYSIS	CONFIG	CALIB	DIAG	EXIT
VIEW/MODIFY							
RECALL							
CATALOG							
MAINTAIN							

6.3.2 Use arrow key to highlight the **RECIPE** column, and then go down to the **CATALOG** menu. Press **ENTER** to select **CATALOG**. This will display a list of available recipes.

6.3.3 Use the arrow key to highlight program needed. If you scroll down past the letter “p” the computer will crash.

6.3.4 Once the correct sequence is highlighted, press the **ENTER** key to select the sequence.

6.3.5 Alternately you may highlight **RECALL** under the **RECIPE** column and type in the recipe that you want to use.

6.4 Loading wafers

6.4.1 The wafer stage should be positioned towards the front of the machine. If it is not, press the **LOAD** button on the upper right portion of the keyboard. The stage will move forward for wafer loading.

6.4.2 Open the cover of the Tencor stage area and using wafer tweezers, place the wafer to be scanned on the stage. Orient the wafer with the primary flat toward the back of the machine. Snug the wafer against the locator pins.

6.4.3 While the wafer is held in place, turn on vacuum to the stage to hold the wafer in position. The vacuum **ON/OFF** valve is located on the inside left of the stage cover opening.

6.4.4 Press the **LOAD** button on the upper right portion of the keyboard. The stage will move under the stylus head for measurement.

6.5 Lowering the Stylus

6.5.1 Press the **Theta** key to enable lowering of the stylus. Press the **down arrow** on the keyboard *one time* to bring the stylus into view. Press and hold the **down arrow** to lower the stylus to the wafer.

6.5.2 The **space bar** can be pressed at the same time to speed up the motion. *Be very careful not to ram the stylus into the stage*. Once you can see the stage, release the **space bar** and the motion will slow down.

6.5.3 Press the down arrow again to ensure the stylus is seated in the down position. The stylus will appear as a '**V**' and an inverted '**V**' on the screen. The '**V**' is the actual stylus and the inverted '**V**' is its reflection. The stylus is properly seated when the '**V**s' meet in the center of the screen.

6.6 Measurements

6.6.1 Press the up arrow one time to raise the stylus off of the wafer so that x/y motion can occur without scratching the wafer.

6.6.2 Press **XYZ** to allow x/y movement of the stage.

6.6.3 Press the left, right, up, and down arrow keys to move the stylus to the first position that will be measured.

6.6.4 The stylus needle must now be zeroed for the measurement location. Press the **Theta** button on the keyboard. Now press the **down** arrow on the keyboard. The stylus will now lower to the wafer surface. Once the stylus is down, press the **down** arrow again. The stylus and wafer might shift downward slightly on the screen. The stylus has now been zeroed. Press the **XY** button on the keyboard to bring the system back into stage movement mode.

6.6.5 Use the arrow keys to position the feature that will be measured. The XY movement mode should be in **PRECISION**. On the left hand side of the screen, the XY movement mode is listed as **HIGH**, **LOW** or **PRECISION**. Toggle the **F1** key until the **PRECISION** mode is shown.

6.6.6 Once the feature is in position, press the green **START** button on the keyboard. The stylus will lower and begin the scan. When the scan is finished, the trace will be displayed.

6.7 Leveling a Scan

6.7.1 If the scan comes up and appears like the one shown below in **Figure 1**, the scan is not level. The step height is not really 1.230 μm as shown below. This is an artifact that is a result of the left and right measurement cursors using the average value between them.

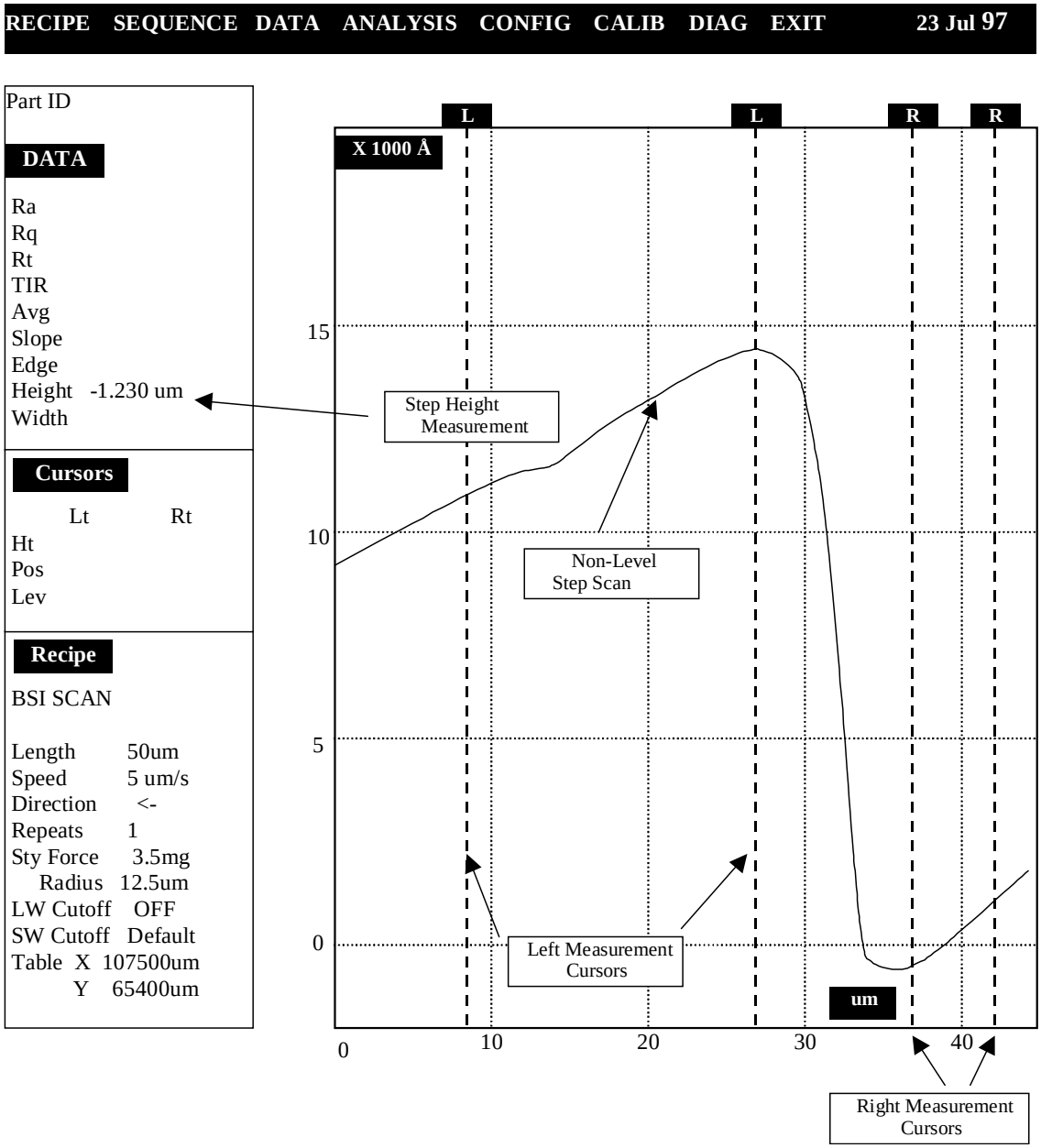

Figure 1. Non-level Tencor Scan

6.7.2 Press the **LEVEL** button on the right hand side of the keyboard to replace the measurement cursors with the leveling cursors. The scan will now look like Figure 2.

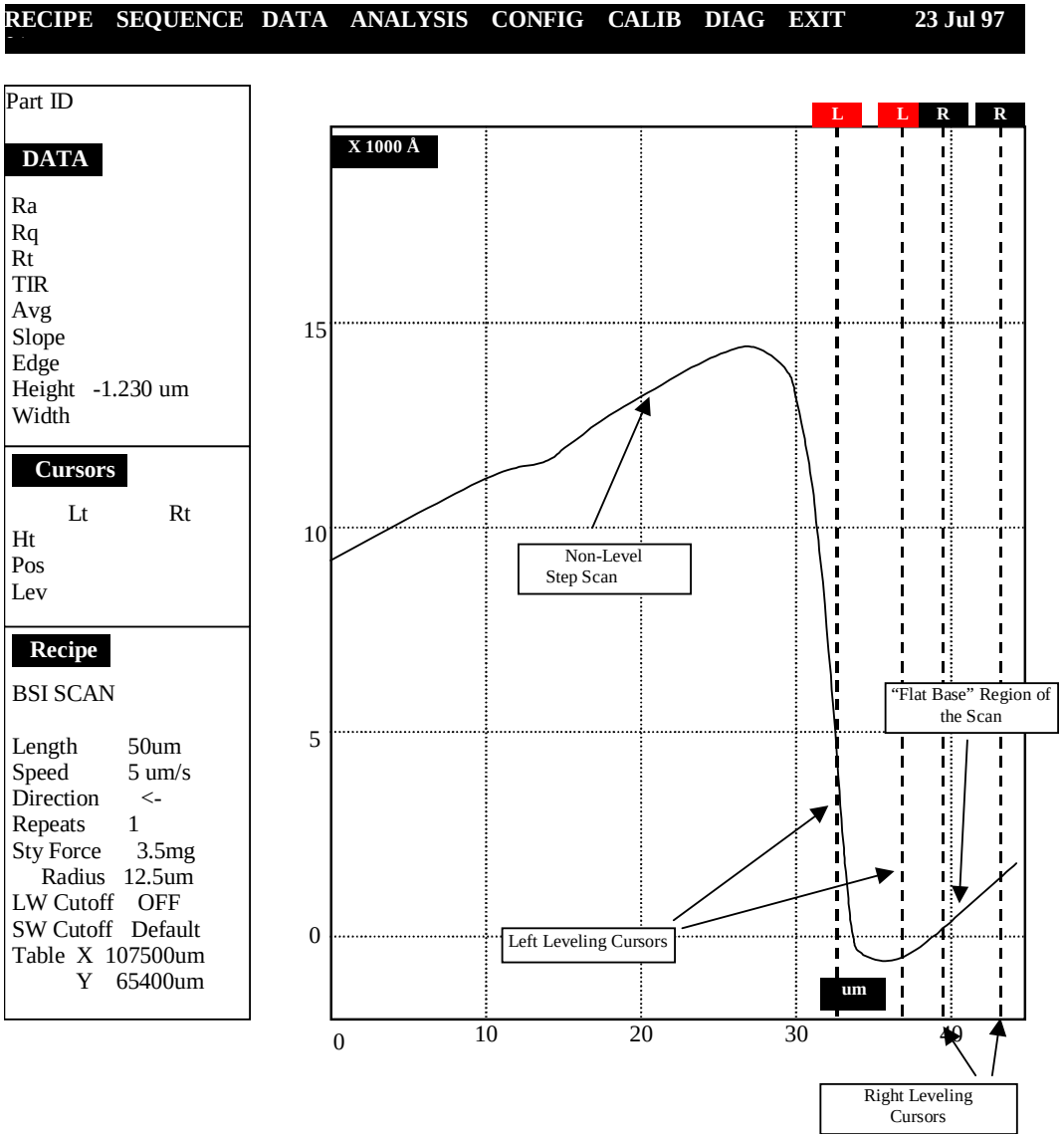

Figure 2. Tencor Trace with Leveling Cursors Shown

6.7.3 Either the left or the right set of cursors will be enabled as indicated by the highlighted characters at the top of the scan. Toggle between the two sets of cursors by pushing the **space** bar on the keyboard. Using the left or right arrow keys move the cursors into the flat base region on the graph. The scan should now look like that shown below in Figure 3.

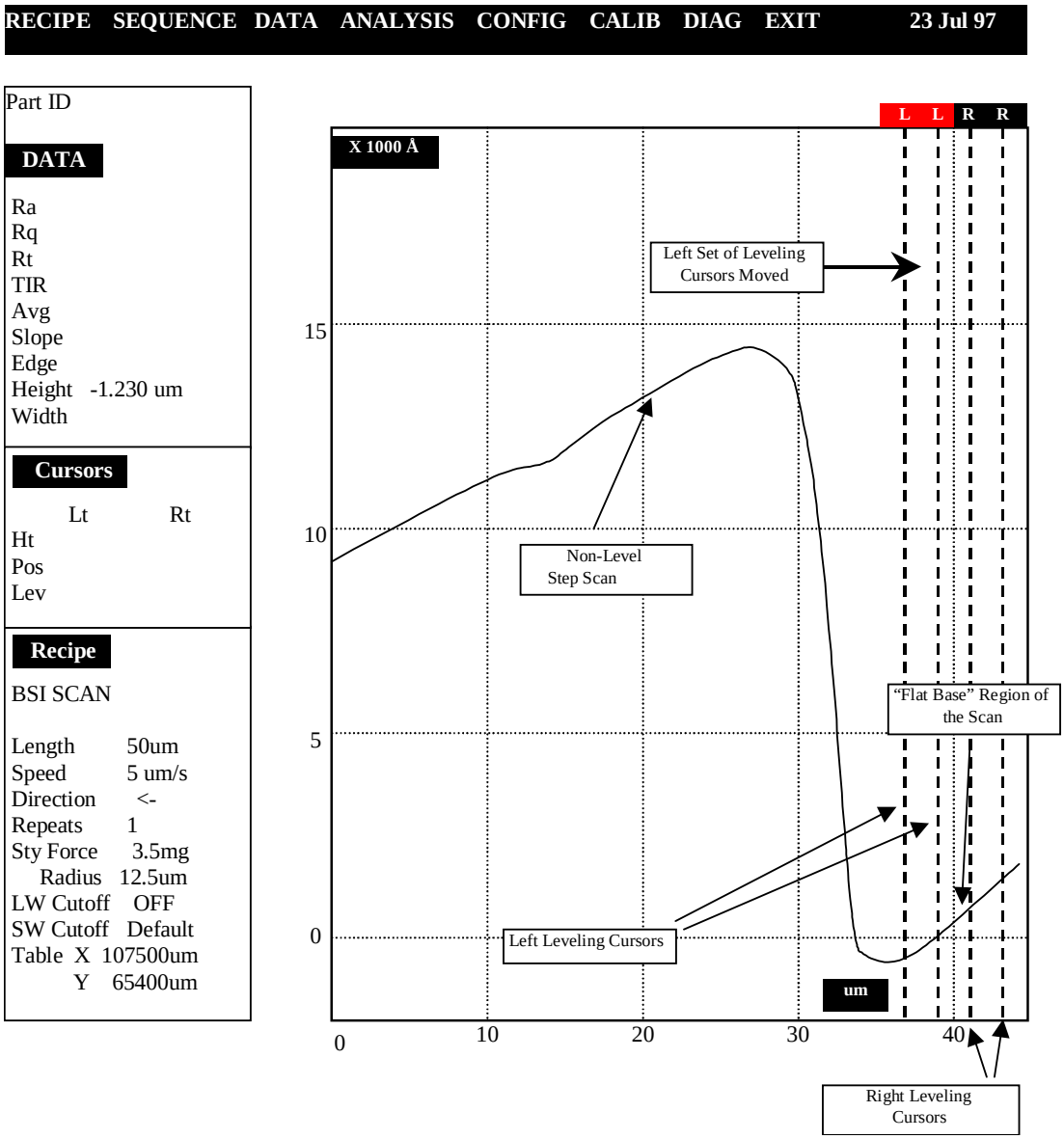

Figure 3. Tencor Trace with Leveling Cursors Set Properly

6.7.4 Once the leveling cursors have been moved into the "Flat Base" portion of the scan, press the **LEVEL** button again to re-level the scan according to the new leveling

cursor positions. Repeat this procedure if necessary, the "flat base" should be closely aligned with the horizontal zero. The scan should now look like that of Figure 4.

6.7.5 The measurement cursors are now displayed and may be positioned with the arrow keys. Record the step height and proceed with the measurements.

6.7.6 To print the display make sure the printer is on line and press the **PRINT** button. The printer only takes one sheet of paper at a time.

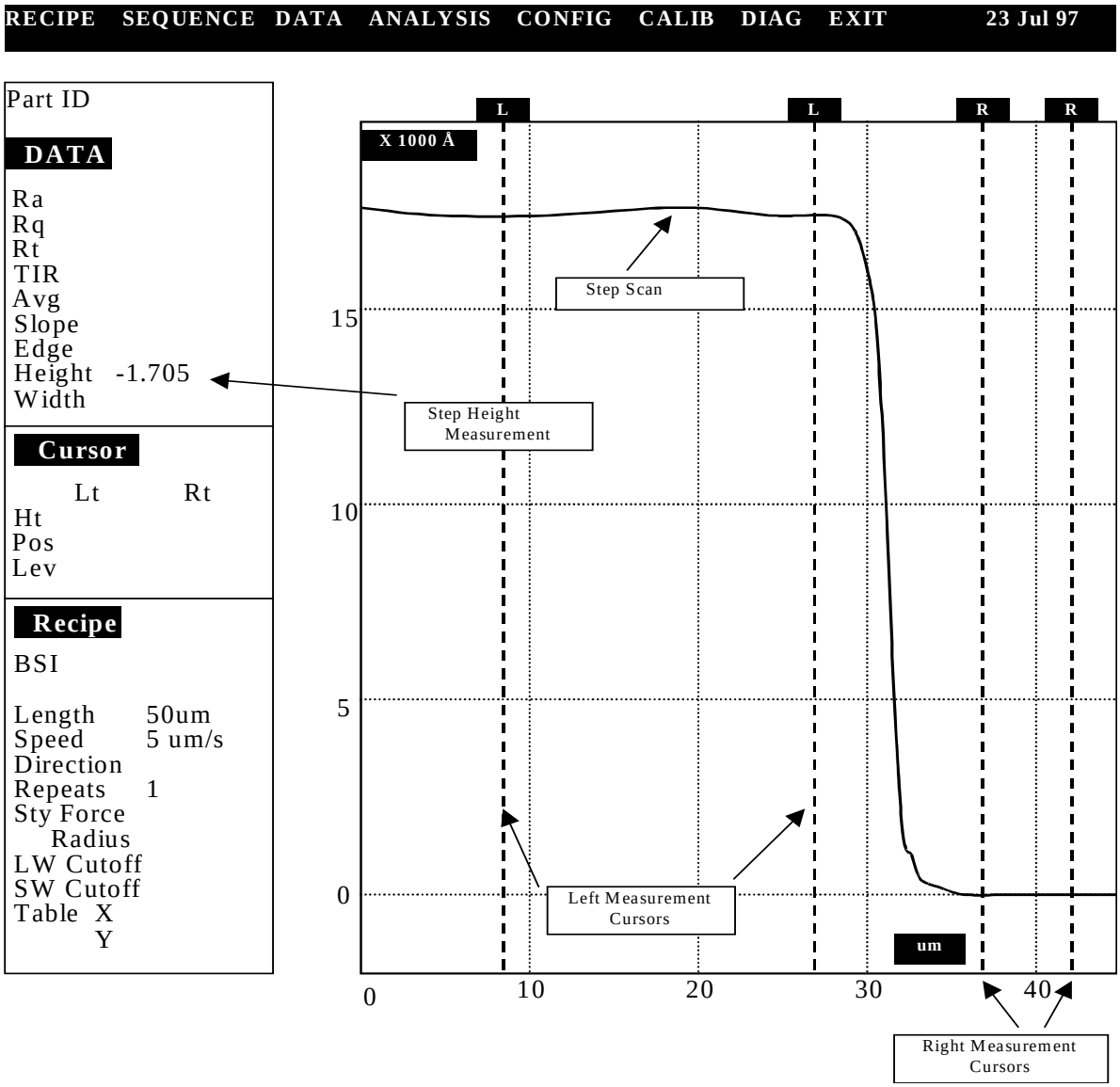

Figure 4. Typical Tencor Scan

6.8 Removing a Wafer

6.8.1 When the wafer is finished, raise the tip and press the **LOAD** key and wait for the stage to stop before releasing the chuck vacuum and removing the wafer. Return the wafer to the cassette for further processing.

6.8.2 Turn off the monitor when you are done.

6.9 Taking a Stress Measurement

6.9.1 Load your program as described in previous steps. You may use **4_IN_STRESS**, which is a 75mm scan for 4-inch wafers, or **6_IN_STRESS**, which is a 125mm scan for 6-inch wafers.

6.9.2 Make sure that the stylus is raised up. Install the stress fixture, turn on the vacuum and load the wafer.

6.9.3 Position the wafer where the scan should start (about ½ inch from the edge). Note the direction of the scan from the recipe.

6.9.4 Take an initial pre-stress scan by pressing **Start**. Make sure that you are not in the stress screen of the Wafer Stress Option.

6.9.5 The trace will be displayed. **Press F4: Save** to save the pre-stress data.

6.9.6 Enter a part ID and press **enter** to save.

6.9.7 Run the wafer through the stress inducing process.

6.9.8 Load the recipe that was used to take the pre-stress measurement.

6.9.9 Load the stress fixture and position the wafer exactly the same as it was during the first scan.

6.9.10 Choose **Stress** from the **Analysis** menu and press **enter** to display the stress screen.

6.9.11 Enter in the film thickness, substrate thickness and substrate type.

6.9.12 With the stress screen displayed, press **start**.

6.9.13 Use the arrow keys to select the pre-stress data that was used and press **enter** to continue.

6.9.14 The scan will be displayed and the wafer ID will now have a –D after it to indicate that a difference has been calculated. (NAME-D)

6.9.15 When the wafer is finished, press the **LOAD** key and wait for the stage to stop before removing the wafer. Return the wafer to the cassette for further processing. Release the chuck vacuum and remove the stress fixture.

6.9.16 Turn off the monitor when you are done.

6.10 Errors during Run

6.10.2 Occasionally the system will lock up. If this happens, reboot the computer.

6.10.2 If the stylus gets contaminated, it will have to be cleaned. See attachments for cleaning procedure.

7 APPROPRIATE USES OF THE TOOL

7.3 Avoid measuring films that will contaminate the stylus.

7.4 For soft films such as photoresist, use a lower force on the stylus.

8 ATTACHMENTS

8.1 Cleaning the stylus

8.1.1 Locate the **Tencor Tip Cleaning Tool** inside of the P2 (to the left) and place it on the wafer chuck.

8.1.2 Carefully lower the stylus into the material and repeat until it appears clean.

8.1.3 Return the Cleaning Tool to its proper place.

8.2 Writing a recipe

8.2.1 Press **MENU** until the menu bar is displayed.

8.2.2 Choose **View/Modify** from **Sequence** menu and press **enter** to display the current sequence program screen.

8.2.3 Toggle through items with the arrow keys or the trackball and choose appropriate settings.

8.2.4 To save the program press **F1: Save**. At the prompt enter a program name. Use the **Arrow Keys** to navigate the on-screen keyboard and select each character using the **Spacebar**. If you want to overwrite the current program, just press **Enter**.

8.2.5 Programs may also be exported to the A-drive by pressing **F3: Export**.

8.3 Saving Data to a 3.5" Disk

8.3.1 The system is not able to save directly to floppy disk. You must first save to the hard disk and then export to a floppy.

8.3.2 From the menu bar at the top of the screen select Data and then **Catalog/enter**.

8.3.3 Under **Part ID**, type in the name that was used to save the data or use the arrows to search for the file.

8.3.4 Press **F2: Recall** and select your trace from the list.

8.3.5 Press **F3: Export**.

8.3.6 Press **N** for ASCII.

8.3.7 Enter a filename and press **Return**.

8.3.8 Do not remove the disk until the light goes out.

8.3.9 Press **F4: Quit**.

REVISION RECORD

Summary of Changes	Originator	Rev/Date
Original Issue	Sean O'Brien	A-12/23/2002
Added section 8.3, modified 6.3.2.1, other sections were clarified	Sean O'Brien	B- 06/07/2004
Clarified 6.3.4, 6.3.7.1 to raise tip, 6.3.8.6 to save without # sign	Sean O'Brien	C-12/07/2010
Changed format in section 6, Corrected error in 8.2.4	Sean O'Brien	D-02/17/2011